



Western Center for Agricultural Health and Safety (WCAHS) at the University of California Davis

A NIOSH Agricultural Safety and Health Center

PROTECTING FARMERS, FARMWORKERS, FARM FAMILIES & THEIR COMMUNITIES

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Agriculture in the Western United States represents one of the most intensive and productive operations in the world. California's agricultural industry alone is the largest in the nation, producing 11.2% of all U.S. crops with annual revenue of \$43 billion and employing 36% of the nation's farmworkers. WCAHS at UC Davis is uniquely situated to address important current and future issues based on its strategic location in the heart of California's Central Valley and its co-location with UC Davis Schools of Medicine and Veterinary Medicine, the Colleges of Agricultural and Environmental Sciences, and Engineering. The multidisciplinary nature of the Center faculty has facilitated a wide variety of field-oriented research projects, along with diverse trainings and multi-lingual educational programs, and intervention schemes.

Center Priority: IMPACT - Develop and conduct solid transferrable research results, implement outreach/intervention programs (specifically to vulnerable populations), evaluate agricultural injury costs, and create new and maintain communication with regional growers, industry, governmental and non-governmental entities encompassed in agricultural safety and health. By nurturing existing and building new NGO/private industry partnerships (e.g., Reiter Affiliated Companies, the largest multi-berry producer in the world), and partnerships with CalOSHA, CalDIR and CalEPA, we are able to augment NIOSH funding. Partnerships and campus graduate student support allows us to broaden our impact, enhance outreach and training activities and nurture the next generation of researchers.

WCAHS efforts and accomplishments are illustrated and disseminated by diverse and new media outlets (webpage: agcenter.ucdavis.edu, quarterly newsletters, podcasts, multi-social media outlets that include a joint NIOSH 10-Ag Center Health & Safety YouTube channel, Facebook, Twitter, etc.). The successes and outcomes of all Center activities are evaluated within our new comprehensive evaluation program on an on-going basis.

The WCAHS Administrative Core provides the infrastructure, outreach/relationship building, and support for the Center's day-to-day functions (NIOSH grant and multiple sub-contracts' management, including meetings of the Administrative Committee, Steering committee, External Advisory Board, and Strategic Planning). Administrative Core management provides leadership input for NIOSH and NORA/AFF collaborative efforts, and guides WCAHS' three Administrative Core Programs: 1) Outreach; 2) Pilot Grants/Feasibility; and 3) Evaluation.

Key Personnel

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I. Administrative Core

I.a. Strategic Planning Highlights: “Agricultural Health: Increasing Our Impact”

- Prevent Heat Illness: Engineering, Behaviors & Regulations**

Focusing on vulnerable workers and the reality growers face, input was sought from: Patty Rominger/Safety Coordinator, Rominger Brothers 6000 acre family farm; Director Uwe Reischl, Community & Environmental Health, Boise State; Phil Harber, Professor of Public Health, University of Arizona; and Guadalupe Sandoval/California Agricultural Labor Contractors Association. Sandoval addressed problematic workforce factors, such as an immigrant workforce, possible health complications, worker lack of training, empowerment, and unawareness of workers compensation. Sandoval added, “The reality is workers will risk health for immediate monetary gains”.

- Engineering Impacts to Reduce Health & Safety Risks**

Professor Stavros Vougioukas, from UC Davis Bio and Ag Engineering, Mechanized labor aids make it easier and faster for humans to harvest specialty crops. The proven time-intensive approach of engineering is to “re-design, rebuild, and evaluate.” Today, the Tomato Harvester, a successful design example, is the norm. Similarly, small robots are currently used to unload strawberry trays. Increased efficiency and robots that monitor worker conditions are two important goals.

Professor Ken Giles, the UC Davis Bio and Ag Engineering Department Chair, shared his work with unmanned aircraft “drones”, of which there is a growing interest for agricultural asset tracking and inspections. Drones are a fit for Western agriculture, especially for commercial spraying of specialty crops in small complex environments, such as grapes. Grower Tony Turkovich, Button-Turkovich Farms, commented on the value he sees for drones in agriculture today, specifically with irrigation of his 6000 acres. These types of interaction/workshops are invaluable – bringing researchers and growers to the table.

I.b. Outreach Program

WCAHS affiliated faculty and the WCAHS Education and Outreach Specialist conduct varied and largely field-oriented outreach and research projects. Notably, our MICASA cohort study of 400+ farmworker families in Mendota, CA, which laid the foundation for an on-going partnership with Reiter Affiliated Companies (RAC), the “PASOS-Saludables” Year 2 farm family health study, which allows us to reach extremely vulnerable groups through their place of employment. The following are examples of other successful outreach programs:

- Worker Occupational Safety & Health Training & Educational Program (WOSHTEP) with partner CalDIR**

This program is in its 5th year and is centered on creating an Illness & Injury Prevention Program (IIPP) bilingual training guide to enable growers, farm labor contractors, and in-the-field supervisors to generate their own comprehensive/tailored illness and injury prevention program.

- Personal Protection Heat Illness Prevention Education**

Heat illness prevention education and tail-gate training to farmworkers is conducted throughout the Central Valley. These hands-on trainings provide take-home materials in English, Spanish, Punjabi and Hmong.

- **Compliance Training for CalOSHA Heat Law Requirements**

We trained approximately 250 growers, farm labor contractors, and supervisors in English and Spanish regarding CalOSHA heat law requirements.

- **Collaboration with CalPoison on Pesticide Safety**

Noting the prevalence of mobile phones and internet access among impoverished migrant farm workers, we developed 5 Spanish language 2-minute videos about pesticide safety in the work area and at home. Eight 6-hour Train-the-Trainer workshops on pesticide safety with 192 grass roots community leaders were conducted. Videos at: <http://www.thesafetyofyourfamily.com/> and <http://agcenter.ucdavis.edu/>

- **Support of the Health Initiatives of America (HIA)**

We have worked to support HIA with its innovative educational virtual portal (see <http://migranthealth.ucdavis.edu/>) to improve health and safety training for *promotoras* embedded in rural communities of non-English speaking farm workers in the U.S. and Mexico.

I.c. Pilot/Seed (Mini Grant) Program

The NIOSH funded WCAHS Seed Grant program seeks to encourage the development of creative research, prevention/intervention, translational, training and outreach projects while nurturing researchers — particularly early-stage researchers, interested in agricultural health and safety. The program is open to WCAHS four-state region: AZ, CA, HI, NV.

Three WCAHS Seed Grants were awarded for Grant Year 2012 – 2013: 1) Respirator training module for pesticide handlers and applicators, Lisa Blecker, MS; 2) Immune-mediated mechanisms of agricultural particle-induced lung inflammation and injury, Alexa Pham, MS, who was able to build on PI Kent Pinkerton's novel extraction protocols for separating coarse particulate matter collected from an agricultural site; and 3) Development and field evaluation of summer garments for California agricultural workers, Co-PIs Gang Sun and Uwe Reischl.

I.d. Evaluation Program

The evaluation team meets annually with WCAHS investigators to review program-specific logic models. The exercise allowed each project to 1) articulate the “theory of change” underlying their program activities, 2) identify and update outcome measures and data sources, and 3) ensure that outcomes and impacts are aligned with NIOSH Agricultural Safety and Health Centers program objectives and relevant NORA Strategic Goals. Data on activities and outcomes is entered into a database management system for WCAHS utilizing Microsoft Access. In the coming months, electronic forms will be sent to project staff to input their information directly into the system, thereby improving efficiency and accuracy.

The WCAHS Evaluation Program team participated in the initiative-wide NIOSH Ag Center evaluation workgroup, “Evaluators, Coordinators, & Outreach Personnel (ECO)”, held April 2013 in Ft. Collins, CO. They developed a poster highlighting key WCAHS accomplishments in promoting agricultural health and safety that was presented at the WCAHS Annual Strategic Planning Retreat in September 2013 and distributed their survey to WCAHS stakeholders/attendees. The survey asked stakeholders to rate the value of WCAHS and WCAHS products. The Stakeholders’ Survey also solicited respondents’ perceptions of the center’s influence and their understanding of regional agricultural health and safety issues. The responses were overwhelmingly positive. Poster and Report available at: <http://agcenter.ucdavis.edu>

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II. Research Projects 1, 2, & 3: Highlights

II.a. Project 1: PI Kent Pinkerton, PhD, "Effects of California Agricultural Particulate Matter in a Murine Intranasal Sensitization Model of Allergic Airway Inflammation"

Challenge: Protocol development and testing of filter extraction methods for removing particulate matter. Extraction in triplicate of particulate matter (PM) samples collected during the winter and summer months. Development of an allergic mouse model using ovalbumin and house dust mite allergen to test agriculturally-based PM and combustion particles.

Impacts:

- The ability sample in real-time particles based on size and composition has allowed us for the first time to examine the health effects of source-oriented PM. Our studies for different seasons (summer and winter) have demonstrated differences between biomass burning, vehicular emissions and metals for both respiratory and cardiovascular endpoints in laboratory animals that have a direct correlation to potential human health impacts.
- Field filter extraction methods have been perfected to more completely remove a better representative range of particles collected in the agricultural setting.

Milestones:

- Demonstrated how in utero and postnatal tobacco smoke exposure in mice shapes the airway immune response to the combined exposure of ovalbumin (OVA) and agricultural particulate matter (PM).
- Completed, validated and implemented novel sample preparation protocols for measuring the capacity of extracted PM samples to form reactive oxygen species (ROS). All ultrafine and submicron fine source-oriented samples (winter and summer) from the San Joaquin Valley have been analyzed for ROS.
- Designed and completed comparative toxicological studies looking at differences between the toxicological responses elicited by urban versus rural (agricultural) PM using both pulmonary and cardiovascular endpoints.
- Completed, validated and implemented novel sample preparation protocols for measuring the metals content of extracted PM samples via inductively coupled plasma-mass spectrometry.
- Completed, validated and implemented novel sample preparation protocols for chemically characterizing extracted PM samples, including elemental carbon/organic carbon (EC/OC) via Thermal/Optical Reflectance (TOR), speciated organic compounds (e.g., hydrocarbons, PAHs, etc.) via Thermal Desorption-Gas Chromatography Mass Spectrometry (TD-GCMS), inorganic ions via Ion Chromatography (IC), Automated Colorimetry (AC) and Atomic Absorption Spectrophotometry (AAS) and water-soluble organic compounds and organic acids via IC. All PM2.5 samples, from winter and summer seasons, underwent this analysis.
- Completed, validated and implemented novel extraction protocols for separating coarse PM collected from an agricultural site from aluminum substrates for subsequent toxicological testing.

- Designed and in process, a field study at the Kearney Agricultural Research and Extension (KARE) Center in Parlier, CA, aimed at collecting temporally-resolved, size-segregated PM from an agricultural setting for subsequent toxicological testing. Four separate ChemVol samplers were configured to sample ultrafine, submicron fine, supermicron fine and coarse PM at different times of day corresponding to (1) the nocturnal inversion (00:00-06:00), (2) breaking of the nocturnal inversion (06:00-12:00), (3) development of the mixed layer and peak actinic flux (12:00-18:00) and (4) formation of the nocturnal inversion and residual layer (18:00-24:00). A PM2.5 high-volume sampler and 5-stage cascade high-volume sampler are also running in parallel to collect continuous, size-segregated PM samples. Collocated instrumentation for monitoring air quality include (1) a Scanning Mobility Particle Sizer providing 15 minute resolution measurements of the size distribution of particle number concentration in the range 10-800 nm, (2) an Aerosol Particle Sizer providing 5 minute resolution measurements of the size distribution of particle number concentration in the range 0.6-20 μ m, (3) two DustTrak monitors providing 15 second resolution measurements of PM2.5 and PM10 mass concentration, (4) wind direction and speed sensors providing 15 second resolution measurements of wind speed and direction, (5) temperature and relative humidity data logger providing 5 second resolution measurements of temperature and relative humidity and (6) a time-lapse camera providing one minute resolution 360° panoramic pictures of the sampling site and surrounding area. This study was started in mid September and is still ongoing to capture the peak in the harvest season when there is significant activity and potential exposure to high levels of PM.

II.b. Project 2: PI J. Paul Leigh, PhD, “Using Large National datasets (NAWS) and Econometrics in Agricultural Injury Research”

Challenge: Demonstrate valid estimates of the number and types of agriculture-related injuries and illnesses leading to improved comprehensive surveillance of the agricultural health and safety systems. Obtaining reliable estimates for employment (denominators) in agriculture for lost-work-time injuries across demographic categories has been challenging but progress has been made.

Impacts:

- Findings that reported agricultural injury and illness cost the U.S. \$8.3 billion in medical costs and lost productivity, greater than the cost of hepatitis C to the entire U.S. population, presented to Washington D.C. legislators.

Milestones:

- Based on analysis of data drawn from the Bureau of Labor Statistics' Survey of Occupational Injury and Illness (BLS-SOII). Found that undercounts for crops and livestock industries are much greater than undercounts in manufacturing.
- Acceptance of paper entitled “An estimate of the U.S. government undercount of non-fatal occupational injuries and illnesses” with co-authors Steve McCurdy and Juan Du by Annals of Epidemiology on January 8, 2014.
- Found that time trends for crops and livestock appear to be more erratic than those for manufacturing.
- Began assessing predictors of which groups of farm workers are covered by insurance, access medical care, report barriers to care, work for contractors and work excessive hours. Data will be drawn from the National Agricultural Workers Survey (NAWS).

- Significant progress in the analysis of NAWS data with the help of a recent economics PhD student from UC Davis, Yoon-Kyung Chung. We have driven to Burlingame, Ca, to analyze the "restricted" NAWS data that contain information on the geographic location of respondents. Preliminary analysis was restricted to a sample of all hired farm workers from 1993 - 2009 with non-missing data. The sample consisted of 41,324 farm workers ages 14 to 90; and 21,273 documented workers versus 20,051 undocumented workers. We have now completed a paper on Medicaid use. We found that undocumented farm worker households were far less likely than documented worker households to receive Medicaid benefits. We also found that undocumented participation in Medicaid was strongly affected by presence of children in the household. This paper is currently under review by BMC Health Services Review.
- Analysis of the Medical Expenditure Panel Survey (MEPS) and the Health and Retirement Survey (HRS) data for the purpose of estimating disparities and time-trends in disparities between agriculture and all other industries for insurance coverage and physical functioning of persons employed in those industries has begun. Both data sets require considerable effort prior to analysis of persons employed in agriculture. Both data sets acknowledge that their coverage of agricultural workers including self-employed farmers is less extensive than their coverage of workers and the self-employed outside agriculture. Nevertheless, we have made a preliminary estimate: in recent MEPS years, 2003-2008, roughly 58% of workers have reported employer-provided medical insurance for all industries combined but within agriculture, that number has been less than 30%.

II.c. Project 3: PI Jerold Last, PhD, “Impacts on New Caging Laws in California on Worker Health & Safety in Layer Hen Facilities”

Challenge: To determine the effect on exposure of workers to toxic air pollutants upon housing layer hens in unconventional facilities required to achieve compliance with the new caging laws in California (and elsewhere).

Milestones:

- Type of caging: On a comparable dose basis, particles from barns with conventional caging are less toxic by the criterion of inducing oxidative stress in cultured macrophages than are particles collected in winter or spring from barns with enriched cages or aviary housing.
- Seasonal differences: PM collected in the summer had comparable toxicity at a constant dose from all three types of caging. Thus, there were seasonal differences between particles observed in these assays.
- Mechanistic studies: Based upon inhibition studies with Polymyxin B, about half to all of the oxidative stress caused by the PM from the layer hen barns was due to endotoxin in the particles.
- Relative toxicity of PM from layer hen barns with different types of caging: Based upon the combination of toxicity per unit dose of PM and total dose of PM the workers would receive in the barns, we would rank the relative risk to workers in these barns containing the three different types of caging as follows: Conventional < Enriched < Aviary.

III. Prevention /Intervention Projects 4, 5, & 6: Highlights

III.a. Project 4: PI Bruce D. Hammock, PhD “Rapid Assays for Human and Environmental Exposure Assessment”

Challenge: Immunoassays for quick and cost effective detection of agricultural worker exposure to pesticides have been widely adopted in the U.S. and elsewhere, and novel tools are now being tested to permit immediate on site detection of harmful pesticide exposures. Additionally, the tools are being tested in the homes of immigrant farm worker families who live in close proximity to agricultural fields and who are often faced with poor housing conditions, causing higher pest infestation and more indoor pesticide use.

Impacts:

- The research contributes to the body of knowledge that will provide guidance to educators to inform the public on pesticide safety.
- Assays developed add to the number and variety of immunoassays that can be utilized by researchers for both human and environmental exposure assessment.

Milestones:

- Haptens have been designed and synthesized for 2,4-D. Resulting immunogens were used to immunize rabbits to generate polyclonal antibodies. Antibody screening is underway. Design and synthesis of haptens for chlorantraniliprole are complete.
- Development and implementation of new technologies resulting in immunoassays for human pesticide exposure that are improved in sensitivity, speed, portability and reproducibility.
- Development of new antibodies/immunoassays to detect 3-phenoxybenzoic acid (3-PBA), a major breakdown product of some pyrethroid insecticides that are used to control insects in crops and around the home. 3-PBA is found in the urine of exposed people. The new assay could detect even smaller amounts of 3-PBA (as low as 0.01 ng/mL) than the conventional antibody assay. This same technology is under development for the herbicide paraquat, which is still used widely as an alternative to glyphosate-resistant weeds.

III.b. Project 5: PI Marc B. Schenker, MD, MPH, “Reducing the Risk of Heat-related Illness in Western Agricultural Workers”

Challenge: Advance the understanding of the physiological responses to increased environmental heat and physical exertion among farm workers through the analysis of personal characteristics, monitors and sensors.

Impacts:

- The information abstracted from 5 focus groups and 15 key informant interviews by the California Institute for Rural Studies (CIRS) in the summer of 2013 have revealed that heat illness education or

advice is preferred orally rather than in writing, or even in picture formats. The results will be used to inform future focus groups and summer field studies in 2014 and 2015.

Milestones:

- One hundred workers were assessed between late June and August 2012, on seven different farms in the California Central Valley. Despite drinking a median volume of 96.5 oz of liquids, of which 68 oz was water, 22% lost over 1.5% of their original body weight (ACGIH suggested criteria of increased risk of dehydration), 80.2% exhibited increased serum osmolality, with 21% experiencing at least a 3% increase. Analysis of these data are continuing.
- Further characterization of the response of the internal temperature probe to controlled levels of various physiological tasks such as, exercise, rest and drinking different volumes of hot and cold beverages. Accelerometers were included in the protocol to determine whether they would enhance the measurement of work-rate.
- Data analysis progresses on the 354 study members who worked in farm labor tasks in the last year before they were interviewed. Forty percent of the workers (but 54% of females) had experienced at least one symptom of heat related illness, the most common symptoms in decreasing order were: dizziness, nausea and muscle cramps. The results will be discussed in future focus groups and summer field studies in 2014 and 2015.

III.c. Project 6: PI Fadi Fathallah, PhD, “Effects of Ladder Rung Spacing on Agricultural Workers”

Challenge: The ladder rung spacing project is a multi-year effort to model and develop an optimized ladder design to reduce falls in agricultural orchard work. The overall work includes theoretical modeling, laboratory testing and validation, and subsequently testing and validation work in the production agriculture environment. Developing relationships with the ladder and orchard industries is an important element.

Milestones:

- Continued work with computerized model development using the AnyBody Modeling System, preliminary laboratory study trials with electromyography and lumbar motion exoskeleton-derived analysis data, anthropometric analysis, and continued relations with our industry partners including fruit growers and ladder manufacturers.
- Two orchard ladder companies continue to support the project efforts. One has provided electronic files of their orchard ladder product to assist in model development and testing efforts. Both have offered to help in whatever manner they can. Contacts have been being maintained both with the industry at the annual World Ag Expo in Tulare, CA, and at other times during the year.
- Outreach has occurred effectively in several other ways. Short presentations on the ladders project continue to be made during frequent tours of the Heidrick Western Center for Agricultural Equipment, where this ladders project is based on the UC Davis campus. An extended project background and objectives session was provided for an agricultural safety engineer and instructor of the California Occupational Safety and Health Administration, who expressed interest at the 35th Annual Symposium of the Northern California Center for Occupational and Environmental Health. At this

event also, we engaged California Governor Gerry Brown in conversation about the project, including his own experiences with ladders.

- We developed and presented ladder and back safety training for the California Farm Bureau, Sacramento County annual Safety Symposium. The day-long program was attended by nearly 150 persons, covering multiple topics ahead of the local harvest season. Hour long presentations were done in English for the managers group, and separately for the workers (about 140) assisted by a Spanish translator. The workers appreciated especially the ability to view and handle all sorts of hardware including the prototype orchard ladders, low-back stress-reducing assistive devices, and the exoskeleton data collection and analysis instrumentation.
- A presentation was made on efforts to date at the 2013 Annual International Meeting of the American Society of Agricultural and Biological Engineers, titled "A Preliminary Evaluation of the Effects of Orchard Ladder Rung Spacing on Workers' Health and Safety."
- A peer-reviewed journal paper that focuses on a review of the current and previous biomechanical literature related to ascending and descending steps, ladders, and stairs is in preparation for submittal to the *Journal of Agricultural Safety and Health*.

IV. Outputs

IV.a. Publications

Leigh

Leigh JP, Du J, McCurdy SA. How much does the US government undercount nonfatal occupational injuries and illnesses in agriculture? *Annals of Epidemiology* 12/10/13 #13-364R1 Accepted 1/8/14

Leigh JP, Marcin JP. Workers' compensation benefits and shifting costs for occupational injury and illness... *J Occup Environ Med.* 2012 Apr; 54(4):445-50.

Hammock

Thiphom, S., T. Prapamontol, S. Chantara, A. Mangklabruks, C. Suphavilai, K.C. Ahn, S.J. Gee and **B.D. Hammock**. 2012. An enzyme-linked immunosorbent assay for detecting 3-phenoxybenzoic acid in plasma and its application to farmers and consumers. *Anal. Meth.* 4:3772-3778.

Kim, H.J., M. McCoy, Z. Majkova, J. Dechant, S.J. Gee, S. Tabares-da Rosa, G.G. Gonzalez-Sapienza and **B.D. Hammock**. 2012. Isolation of alpaca anti-hapten heavy chain single domain antibodies for development of sensitive immunoassay. *Anal Chem.* 84(2):1165-71. PMCID: PMC3264785.

Trunnelle, K., D.H. Bennett, D.J. Tancredi, S.J. Gee, M.T. Stoecklin-Marois, T.E. Hennessy-Burt, B.D. **Hammock, M.B.** Schenker. 2013. Pyrethroids in house dust from the homes of farm worker families in the MICASA study. *Env. Int.* 61C:57-63.

Thiphom, S., T. Prapamontol, S. Chantara, A. Mangklabruks, C. Suphavilai, K.C. Ahn, S.J. Gee and **B.D. Hammock**. 2013. Determination of the pyrethroid insecticide metabolite 3-PBA in plasma and urine samples from farmer and consumer groups in northern Thailand. *J. Environ Sci Health B.* 49:15-22.

Schenker

Armitage T, Mitchell D, **Schenker M**. "Mortality in the California Farmer Health Study Cohort". *Journal of Agromedicine*, 17:288-299, 2012

Vogel C, Garcia J, Mitchell D, Kado N, Tancredi D, Wu D, Trujillo DA, Bennett DH, **Schenker MB**, Mitloehner FM. "Activation of inflammatory responses in human U937 macrophages by particulate matter collected from dairy farms: An in vitro expression analysis of pro-inflammatory markers." *Environmental Health*. 2012. Pages 11-17.

Garcia J, Bennett DH, Tancredi DJ, **Schenker MB**, Mitchell DC, Reynolds SJ, Silva R, Dooley GP, Mehaffy J, Mitloehner FM. "Characterization of Endotoxin Collected on California Dairies Using Personal and Area-Based Sampling Methods." *Journal of Occupational and Environmental Hygiene*, Manuscript ID: 713301, 9: 580-591, October 2012.

Eastman C, **Schenker MB**, Mitchell DC, Trancredi DJ, Bennett DH, Mitloehner FM. "Acute pulmonary function change associated with work on large dairies in California." *Journal of Occupational and Environmental Medicine*. Volume 55, Issue 1, Jan 2013, Pages 74-79.

Xiao H, McCurdy SA, Stoecklin-Marois MT, Li CS, **Schenker MB** "Agricultural Work and Chronic Musculoskeletal Pain Among Latino Farm Workers: The MICASA Study." American Journal of Industrial Medicine, 2012: 56, Feb 2013, Pages 216-225.

Stoecklin-Marois MT, Hennessy-Burt T, Mitchell D, **Schenker MB**. "Heat-related illness knowledge and practices among California hired farm workers in the MICASA Study." 2013. Industrial Health 2013, 51, 47–55

McCurdy SA, Xiao H, Hennessy-Burt TE, Stoecklin-Marois MT, Tancredi DJ, Bennett DH, **Schenker MB**. "Agricultural injury in California Hispanic farm workers: MICASA follow-up survey." Journal of Agromedicine. 2013;18(1):39-49. doi: 10.1080/1059924X.2012.743380.

Garcia J, Bennett D, Tancredi D, **Schenker MB**, Mitloehaner, F. "A Survey of particulate matter on California dairy farms." Journal of Environmental Quality 01/2013 42(1):40-47.

O'Connor K, Stoecklin-Marois M, **Schenker MB**. Examining nervios among immigrant male farmworkers in the MICASA Study: Sociodemographics housing conditions and psychosocial factors. Journal of Immigrant and Minority Health. June 20, 2013. Vol 15.

Schenker MB. Occupational health in the dairy industry needs to focus on immigrant workers, the new normal. Journal of Agromedicine. June 11, 2013. Vol 18 Issue 3. Page 184-186.

Garcia J, Bennett D, Tancredi D, **Schenker, MB**. "Occupational exposure to particulate matter from three agricultural crops in California". International Journal of Hygiene and Environmental Health, June 12, 2013 [Epub ahead of print].

Reynolds SJ, Nonnenmann MW, Basinas I, Davidson M, Elfman L, Gordon J, Kirychuk S, Reed S, Schaeffer JW, **Schenker MB**, Schlunssen V, Sigsgaard T. Systematic Review of Respiratory Health Among Dairy Workers. Journal of Agromedicine. 2013, Vol 18 Issue 3, Page 219-186.

Matias SL, Stoecklin-Marois MT, Tancredi DJ, **Schenker MB**. "Adherence to dietary recommendations is associated with acculturation among Latino farm workers." Journal of Nutrition, Sep 2013; Vol 143 no. 9, Page 1451-458.

IV.b Presentations

Hammock

Invited oral presentation entitled "Immunoassay for Human/Environmental Exposure Assessment" was presented at the Pittsburgh Analytical Conference (PittCon 2013) March 17, 2013, Philadelphia, PA

Fathallah

2013 Annual International Meeting of the American Society of Agricultural and Biological Engineers, entitled "A Preliminary Evaluation of the Effects of Orchard Ladder Rung Spacing on Workers' Health and Safety."

Pinkerton

"Dose response to Sacramento particulate matter", Van Winkle, L.S., Anderson, D.S., **Pinkerton, K.E.**, Tablin, F.A., Wilson, D.W., Bein, K.J., and A.S. Wexler, 2013 Society of Toxicology Annual Meeting, San Antonio, TX, March 10-14

Wexler, A.S., Bein, K.J. and **K.E. Pinkerton**, Source-Oriented Toxicology of Ambient Fine and Ultrafine PM, California Air Resources Board, Sacramento, CA, February 20, 2013.

Wexler, A.S., Bein, K.J. and **K.E. Pinkerton**, Source-Oriented Toxicology of Ambient Fine and Ultrafine PM, U.S. Environmental Protection Agency, webinar, March 24, 2013.

Pinkerton, K.E., Plummer, L.E., Carosino, C.M., Castaneda, A.R., Bein, K.J. and A.S. Wexler, Cardiopulmonary toxicity of urban source-oriented ultrafine and submicron fine particulate matter from California's San Joaquin Valley, 17th ETH-Conference on Combustion Generated Nanoparticles, June 23-26, 2013.

Bein, K.J., Wexler, A.S. and **K.E. Pinkerton**, Toxicity of Source-Oriented Ambient Submicron Particulate Matter at an Urban Site in Fresno, Risk-Based Strategies for Managing Air Quality: A New Paradigm with Implications for Agriculture in California, U.C. Davis, June 27-28, 2013.

Schenker

"Occupational Health: New Directions and Translations," Speaker, Public Health Sciences Department Faculty Retreat, Sierra Health Foundation, Sacramento, California, May 8, 2013

"The Changing Face of Occupational Hazards," Speaker, 31st Annual Occupational & Environmental Medicine Symposium, UC Davis Health System Medical Education Building Sacramento, CA, May 18, 2013

"Heat Stress in Agricultural Workers" as part of a course on agricultural health in Bogota, Colombia. February 7, 2013 at Pontificia Universidad Javeriana, Bogota, Colombia.

"The Changing Face of Occupational Workforce and Disease," Presenter, 2013 American Thoracic Society International Conference, Pennsylvania Convention Center, Philadelphia, Pennsylvania, May 18-23, 2013

"Latino aging is not just in the mind", Guest Speaker, Latino Aging Research Resource Center, Sacramento, California, June, 13, 2013

"A workplace intervention targeting obesity and diabetes in Latino farmworkers" and "California Heat Illness Prevention Study (CHIPS) in immigrant Latino farm workers," Presenter, EPICOH 2013 - Cancer incidence and mortality in agricultural cohorts in the AGRICOH consortium, Utrecht, The Netherlands, June 18-21, 2013

"Occupational health among immigrants," Presenter, 8th Summer Institute on Migration and Global Health, The California Endowment Conference Center, Oakland, California, June 25, 2013

"Inorganic dust exposure and disease," Guest Speaker, Risk-Based Strategies for Regulating AG Air Quality Impacts, UC Davis Conference Center, Davis, California, June 28, 2013

"Cohort Studies," Mentored Clinical Research Training Program, Clinical and Translational Science Center, Sacramento, California, August 22, 2013

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Perspectives from the Medical Community, Guest Speaker, Sembrando Salud, Reiter Affiliated Companies, Oxnard, California, September 10, 2013

IV.c. Abstracts/Other Outputs/Accomplishments

Schenker

Abstract submitted to the International Conference of Epidemiology in Occupational Health (EPICOH) 2013. Schenker MB, Mitchell DC, Wadsworth G and Jones JH. 'California Heat Illness Prevention Study (CHIPS) in immigrant Latino farm workers.'

Fathallah

Ladder and back safety training for the California Farm Bureau, Sacramento County annual Safety Symposium. Attended by nearly 150 persons, covering multiple topics ahead of the local harvest season. Presentations were done in English for the managers group and separately for the workers (about 140) assisted by a Spanish translator.

Hammock

A postdoctoral researcher obtained a scientist position at the Bayer U.S. Innovation Center in Mission Bay, CA

A postdoctoral researcher obtained an assistant professor position at the University of Alaska Anchorage

One predoctoral student completed her PhD in Agricultural and Environmental Chemistry

We trained one predoctoral student from China in phage display and VHH technology in the course of 18 months that resulted in two peer-reviewed publications

We trained one visiting predoctoral student (phage display assays), one visiting faculty (phage display assays) and one visiting Master's degree student (environmental sample analysis using immunoassay). Visitors generally stayed for 1 to 3 months